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09/885,871	06/20/2001	Masahiro Ooshima	9281-4138	3201

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EXAMINER	
WATKO, JULIE ANNE	
ART UNIT	**PAPER NUMBER**
2652	9

DATE MAILED: 11/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/885,871	OOSHIMA ET AL.	
	Examiner	Art Unit	
	Julie Anne Watko	2652	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3 and 5-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,5-11,18 and 19* is/are rejected.

7)☒ Claim(s) *12-17* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. *09/814,531*.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers (JP 2001-086261) submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file, with the exception of JP 2000-086261, a certified copy of which appears in the parent application (SN 09814531).

Allowable Subject Matter

2. Claims 12-17 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

3. The indicated allowability of claim 11 is withdrawn in view of the newly discovered reference(s) to Gill. Rejections based on the newly cited reference(s) follow.

Claim Rejections - 35 USC § 103

4. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1-2 and 5-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mack et al (US Pat. No. 6462919 B1) in view of Gill '363 (US Pat. No. 6275363 B1).

As recited in claim 1, Mack et al show a spin-valve type thin film magnetic element (see Fig. 6B) comprising: a laminate comprising an antiferromagnetic layer 238, a pinned magnetic layer 236 in contact with an antiferromagnetic layer in which the magnetization direction of the pinned magnetic layer is fixed by an exchange anisotropic magnetic field with the antiferromagnetic layer, and a non-magnetic conductive layer 234 formed between the pinned magnetic layer and a free magnetic layer 232; bias layers 222A and 222B for aligning the magnetization direction of the free magnetic layer in the direction substantially perpendicular to the magnetization direction of the pinned magnetic layer; ferromagnetic layers (224A-B, 226A-B and 228A-B taken together) formed in contact with the bias layers; and conductive layers (302A-B, for example) for applying a sensing current to the free magnetic layer, wherein each of the ferromagnetic layers is divided into two sub-layers (224A and 228A, or 224B and 228B) separated by a first non-magnetic intermediate layer (226A or 226B), the sub-layers being in a ferrimagnetic state in which the magnetization direction of one sub-layer is 180 degrees different from the magnetization direction of the other sub-layer ("synthetic antiferromagnet (SAF)", see col. 8, lines 41-42, for example).

As recited in claim 1, Mack et al are silent regarding whether the free magnetic lacier is divided into two sub-layers separated by a second non-magnetic intermediate layer, the sub-layers being in a ferrimagnetic state in which the magnetization direction of one sub-layer is 180 degrees different from the magnetization direction of the other sub-layer.

As recited in claim 1, Gill '363 teach that it is advantageous when a free magnetic layer is divided into two sub-layers (210 and 212) separated by a second non-magnetic intermediate layer 208, the sub-layers being in a ferrimagnetic state in which the magnetization direction of one sub-layer is 180 degrees different from the magnetization direction of the other sub-layer (see col. 6, lines 12-29, "free layer 212 with a thickness of 60Å of nickel iron (NiFe) is considered sufficient in the art to promote optimized in-phase scattering of the conduction electrons conducted between the AP pinned structure 206 and the AP coupled free layer structure 202. The magnetization of this thickness, however, may be larger than the magnetization of the signal fields from a rotating magnetic disk. With the first AP free layer 210 having a thickness of 30Å of nickel iron (NiFe), for example the AP coupled free layer structure 202 has a net magnetization that is due to only 30Å of nickel iron (NiFe) which is the difference between the thicknesses of the first and second AP free layers 210 and 212. This enables the signal fields from the rotating magnetic disk to have less magnetization which, in turn, enables more magnetic bits to be impressed on the magnetic disk thereby increasing the linear bit density and storage capacity of a magnetic disk drive employed by the sensor.").

It would have been obvious to one of ordinary skill in the art at the time the invention was made to replace the free layer of Mack et al with the sub-layers and intermediate layer of Gill '363 as taught by Gill '363. The rationale is as follows: one of ordinary skill in the art would have been motivated to increase a data density and storage capacity by decreasing a magnetic moment of the free layer while maintaining a free layer thickness sufficient to promote optimized in-phase scattering of the conduction electrons as explicitly taught by Gill '363.

As recited in claim 2, Mack et al show that ferromagnetic layers (including 224A-B, 226A-B, 228A-B) are disposed on the free magnetic layer 232 with a distance corresponding to a track width (see double-sided arrow in Fig. 6B), the bias layers 222A-B being provided on the ferromagnetic layers and the conductive layers 302A-B being provided on the bias layers (although the location of the conductive layers is not explicitly shown in Fig. 6B, it is clear from Fig. 10 that the conductive layers of Mack et al are on exchange tabs 304A-B, wherein the exchange tabs include bias layers and ferromagnetic layers).

As recited in claim 5, Mack et al show that the ferromagnetic layer (including 224A-B) comprises at least one element selected from the group consisting of Ni, Fe and Co ("CoFe layers 224", see col. 9, line 5).

As recited in claim 6, Mack et al show that the bias layers comprise an alloy containing **Mn** and at least one element selected from the group consisting of **Pt**, **Pd**, Rh, **Fe**, Ru, **Ir**, Os, Au, Ag, **Cr**, **Ni**, Ne, Ar, Xe and Kr (see table in col. 8).

As recited in claim 7, Mack et al show that the bias layers comprise at least one material selected from the group consisting of **NiO**, α-Fe_2O_3 and CoO (emphasis added; see table in col. 8).

As recited in claim 8, Mack et al are silent regarding which AFM materials are used for AFM layer 238; however, Mack et al explicitly disclose AFM materials including those claimed (see teachings above regarding bias layers in claim 6).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the claimed materials, including PtMn for the AFM layer of Mack et al. The rationale is as follows: one of ordinary skill in the art would have been motivated to use the

claimed materials, including PtMn, for the AFM layer in order to prevent corrosion and to resist field reversal as taught by Mack et al (see col. 8, line 2).

As recited in claim 9, Mack et al show that the bias layers comprise an antiferromagnetic material (222A-B).

7. Claims 1-3, 5, 9-11 and 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carey et al (US Pat. No. 6266218 B1) in view of Gill '363 (US Pat. No. 6275363 B1).

It is noted by the Examiner that Carey et al uses reference numeral 92 to refer to both a bias layer (see Fig. 9) and a conductive layer (see Fig. 6). The Examiner apologizes for any confusion which may result from this ambiguity of Carey et al.

As recited in claim 1, Carey et al show a spin-valve type thin film magnetic element (see Fig. 9, for example) comprising: a laminate comprising an antiferromagnetic layer 74, a pinned magnetic layer 76 in contact with an antiferromagnetic layer in which the magnetization direction of the pinned magnetic layer is fixed by an exchange anisotropic magnetic field with the antiferromagnetic layer, and a non-magnetic conductive layer 80 formed between the pinned magnetic layer and a free magnetic layer 78; bias layers (92 in Fig. 9) for aligning the magnetization direction of the free magnetic layer in the direction substantially perpendicular to the magnetization direction of the pinned magnetic layer (see arrows in Fig. 9); ferromagnetic layers 90 formed in contact with the bias layers; and conductive layers ("electrical contacts", see col. 7, line 28) for applying a sensing current to the free magnetic layer, wherein each of the ferromagnetic layers is divided into two sub-layers separated by a first non-magnetic intermediate layer, the sub-layers being in a ferrimagnetic state in which the magnetization

direction of one sub-layer is 180 degrees different from the magnetization direction of the other sub-layer (see antiparallel arrows of 84 and 86 in Fig. 9).

As recited in claim 1, Carey et al are silent regarding whether the free magnetic lacier is divided into two sub-layers separated by a second non-magnetic intermediate layer, the sub-layers being in a ferrimagnetic state in which the magnetization direction of one sub-layer is 180 degrees different from the magnetization direction of the other sub-layer.

As recited in claim 1, Gill '363 teach that it is advantageous when a free magnetic layer is divided into two sub-layers (210 and 212) separated by a second non-magnetic intermediate layer 208, the sub-layers being in a ferrimagnetic state in which the magnetization direction of one sub-layer is 180 degrees different from the magnetization direction of the other sub-layer (see col. 6, lines 12-29, "free layer 212 with a thickness of 60Å of nickel iron (NiFe) is considered sufficient in the art to promote optimized in-phase scattering of the conduction electrons conducted between the AP pinned structure 206 and the AP coupled free layer structure 202. The magnetization of this thickness, however, may be larger than the magnetization of the signal fields from a rotating magnetic disk. With the first AP free layer 210 having a thickness of 30Å of nickel iron (NiFe), for example the AP coupled free layer structure 202 has a net magnetization that is due to only 30Å of nickel iron (NiFe) which is the difference between the thicknesses of the first and second AP free layers 210 and 212. This enables the signal fields from the rotating magnetic disk to have less magnetization which, in turn, enables more magnetic bits to be impressed on the magnetic disk thereby increasing the linear bit density and storage capacity of a magnetic disk drive employed by the sensor.").

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use sub-layers and an intermediate layer for the free layer of Carey et al as taught by Gill '363. The rationale is as follows: one of ordinary skill in the art would have been motivated to increase a data density and storage capacity by decreasing a magnetic moment of the free layer while maintaining a free layer thickness sufficient to promote optimized in-phase scattering of the conduction electrons as explicitly taught by Gill '363.

As recited in claim 2, Carey et al show that ferromagnetic layers 90 are disposed on the free magnetic layer with a distance corresponding to a track width (see Fig. 9), the bias layers being provided on the ferromagnetic layers ("AF layer 92 can At ***(sic)*** also be deposited on top of structure 90", see col. 9, lines 49-51) and the conductive layers being provided on the bias layers ("Electrical contacts 92 are typically made to top bias layer", see col. 7, lines 28-29).

As recited in claim 3, Carey et al show that the bias layers (92 in Fig. 9; see also col. 9, line 49, "AD layer 92") are provided at both sides in the track width direction of the laminate, the ferromagnetic layers 90 being provided on the bias layers, and the conductive layers being provided on the ferromagnetic layers 90 ("Electrical contacts 92 are typically made to top bias layer 84 on both sides of sensor 70", see col. 7, lines 28-29; although the electrical contacts are not explicitly shown in Fig. 9, their location on the ferromagnetic layers 90 is made apparent by 92 in Fig. 6).

As recited in claim 5, Carey et al show that the ferromagnetic layer comprises at least one element selected from the group consisting of Ni, Fe and Co ("Co, Fe, Ni or their alloys", see col. 5, line 43).

As recited in claim 9, Carey et al show that the bias layers 92 comprise an antiferromagnetic material ("AF layer 92", see col. 11, line 33).

As recited in claim 10, Carey et al show that the antiferromagnetic material 92 has a lower heat treatment temperature ("AF layer 92 is made of a low blocking temperature material with blocking temperature T1, and AF layer 74 is made of high blocking temperature material", see col. 11, lines 33-35) than that of the antiferromagnetic layer 74.

As recited in claim 11, Carey et al show that a free magnetic layer comprises a CoFeNi alloy ("Co, Fe, Ni or their alloys", see col. 5, line 43). As recited in claim 11, Carey et al also show Ru as a non-magnetic intermediate layer ("Suitable material choices include Ru", see col. 5, line 32).

As recited in claim 11, Carey et al are silent regarding whether the free magnetic layer comprises a first free magnetic layer and a second free magnetic layer which are separated by the second non-magnetic intermediate layer, the first free magnetic layer and the second free magnetic layer are in a ferrimagnetic state in which the magnetization direction of the first free magnetic layer is 180 degrees different from the magnetization direction of the second free magnetic layer).

See teachings, rationale and motivations for combining teachings above for claim 1.

As recited in claim 18, Carey et al show that the ferromagnetic layer 90 comprises a first ferromagnetic layer 86 and a second ferromagnetic layer 84 which are separated by a non-magnetic intermediate layer 88, the first ferromagnetic layer and the second ferromagnetic layer are in a ferrimagnetic state in which the magnetization direction of the first ferromagnetic layer is 180 degrees different from the magnetization direction of the second ferromagnetic layer (see

arrows in Fig. 9), at least one of the first ferromagnetic layer and the second ferromagnetic layer comprise a CoFeNi alloy ("Co, Fe, Ni or their alloys", see col. 5, line 43), and the non-magnetic intermediate layer 88 (see col. 7, lines 25-26, "non-magnetic exchange coupling layer 88", which performs the same function in the same way as exchange coupling layer 16 in Fig. 2A) comprises Ru ("Suitable material choices include Ru", see col. 5, lines 24-37, especially line 32).

As recited in claim 19, Carey et al show that both the first ferromagnetic layer 86 and the second ferromagnetic layer 84 (wherein 86 and 84 perform the same function in the same way as 12 and 14) comprise the CoFeNi alloy ("top and bottom bias layer 12, 14 are made of a magnetic material such as Co, Fe, Ni or their alloys", see col. 5, line 41).

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Gill '537 (US PAP No. 2001/0028537 A1) teaches that a "prior art single free layer may be required to be as thin as 20 Å of nickel iron (NiFe) in order to match it with low moment signal fields from the rotating magnetic disk. Unfortunately, this thickness is too thin to provide optimized magnetoresistance between the free and pinned layers. ... With the triple AP coupled free layer structure it is only necessary that the net magnetic moment of the free layer structure be matched to the moment of the signal field." (see ¶ 0013).

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Julie Anne Watko whose telephone number is (703) 305-7742. The examiner can normally be reached on Mon&Tue until 2PM, Th until 5PM, Wed&Fri all day.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hoa T. Nguyen can be reached on (703) 305-9687. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-4700.

Julie Anne Watko
Primary Examiner
Art Unit 2652

October 31, 2003
JAW